Campus Infrastructure COVID-19 Mitigation Efforts

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October 28, 2021

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We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally-recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.

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Webinar Notes

- Please submit your questions in the Q&A tab at the bottom of your screen.
- The Chat function allows you to send chat messages to your colleagues in the meeting.
- The webinar Recording, the Q&A feed, the Chat feed, and any presentation materials will be available after the webinar at https://provost.arizona.edu/content/campus-webinars

Facilities Management Mitigation Efforts

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What Has UArizona Done to Prepare Campus for Re-Entry?

- Ramped up cleaning and disinfecting beginning in January 2020 .
- Use of Oxivir cleaner, which kills the COVID-19 virus.
- Adherence to CDC guidelines to ensure the health and safety of the campus community.
- Trained members of our Custodial Staff on COVID isolation, cleaning, including PPE and proper cleaning techniques.
- Centralized PPE purchasing and storage for the campus.
- Our Small Engine Shop has been converted to a disinfecting station, filling and replacing thousands of bottles of disinfectant to share across campus.
- Established Isolation Dorms and student isolation transportation.
- Campus Health provides voluntary vaccinations and COVID-19 testing for symptomatic cases.
- Student Union houses COVID-19 testing.

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Preparing Campus for near-normal operations

To Date:

- 2,000 Sneeze Guards installed
- Signage installed in 100 buildings
- 1,530 Wall Mounted Hand Sanitizers installed
- 2,350 Touch-Free Paper Towel Dispensers installed
- 1,310 Toilet Seat Covers installed
- 8,000 MERV Filters installed

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COVID Clean Ups – August/September 2021

Date	# of Trans.	# of COVID Cleans	# of Dorm Cleans
8/1/2021	0	1	0
8/2/2021	0	1	0
8/3/2021	0	3	0
8/4/2021	0	0	0
8/5/2021	0	1	0
8/6/2021	0	0	0
8/7/2021	0	0	0
8/8/2021	0	0	0
8/9/2021	0	1	0
8/10/2021	0	1	0
8/11/2021	0	0	0
8/12/2021	0	2	0
8/13/2021	0	1	0
8/14/2021	0	0	0
8/15/2021	0	0	0
8/16/2021	0	3	0
8/17/2021	1	0	0
8/18/2021	0	0	0
8/19/2021	0	1	0
8/20/2021	0	0	0
8/21/2021	0	0	0
8/22/2021	0	0	0
8/23/2021	0	0	0
8/24/2021	0	1	0
8/25/2021	0	1	0
8/26/2021	0	2	0
8/27/2021	1	1	0
8/28/2021	0	0	0
8/29/2021	0	0	0
8/30/2021	0	3	0
8/31/2021	1	0	0
9/1/2021	4	0	0
9/2/2021	5	3	0
9/3/2021	0	0	0
9/4/2021	0	0	0
9/5/2021	0	0	0
9/6/2021	0	0	0
9/7/2021	3	3	0
9/8/2021	1	3	0
9/9/2021	2	4	0
9/10/2021	3	3	0
9/11/2021	0	0	0
9/12/2021	0	1	0
9/13/2021	3	5	0
9/14/2021	6	2	0
9/15/2021	4	4	0
9/16/2021	3	4	0
9/17/2021	5	2	0
9/18/2021	1	0	0
9/19/2021	0	0	0
9/20/2021	9	3	0
9/21/2021	3	3	0
9/22/2021	1	2	0
9/23/2021	2	1	0
9/24/2021	5	1	0
9/25/2021	1	0	0
9/26/2021	0	0	0
9/27/2021	1	0	0
9/28/2021	1	4	0

From Left to Right: Custodians Lilliana González, Kyle Graves (temp), and Custodial Project Manager, Jose Solis

Total # of COVID Cleans for August and September 2021 = 71

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The **American Society of Heating, Refrigerating and Air-Conditioning Engineers** (**ASHRAE**) Founded in 1894, is a global professional society with over 57,000 members that are committed to serve humanity by advancing the arts and sciences of heating ventilation, air conditioning, refrigeration and their allied fields.

As an industry leader in research, standards, writing, publishing, certification and continuing education, ASHRAE and its members are dedicated to promoting a healthy and sustainable built environment for all, through strategic partnerships with organizations in the HVAC&R community and across related industries.

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Classroom Air Change Review

Reference Row #	Classroom Data Received from UA			Analysis													
	Building	Descr	Room	Year of Original Construction	Room SF	Room Height (Ft)	Room Volume (CF)	Room Supply Air CFM	Total CFM/SF	Outside Air CFM/SF	AHU Name, DWG Year	AHU Total Supply Air CFM	AHU Outside Air CFM	AHU Outside Air %	Total Supply Air Changes/Hr [(Room Supply Air) x 60 / (Room Volume)]	Outside Air Changes/Hr [(Total Air Changes/Hr) x (AHU Outside Air %)]	Air Changes/Hr (Equivalent. Includes MERV 13 efficacy factor for recirculated air	Pro-Rated Occupancy Limit (Baseline: 6 Air Changes/Hr Min
1	17	Student Union Memorial Center	252	2001	700	13	9,100	-	-	-	-	-	-	-	-	-	-	-
2	17	Student Union Memorial Center	256	2001	834	13	10,842	-	-	-	-	-	-	-	-	-	-	-
3	17	Student Union Memorial Center	264	2001	845	13	10,985	-	-	-	-	-	-	-	-	-	-	-
4	75	Architecture	A304X	1965	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5	89.01	Mathematics Teaching Lab	120	1998	131	9	1,179	-	-	-	-	-	-	-	-	-	-	-
6	89.01	Mathematics Teaching Lab	124	1998	-	-	-	-	-	-	-	-	-	-	-	-	-	-
7	77	Gould-Simpson	228A	1985	1,051	9	9,459	14,840	14.1	0.56	ebert Unit & Fan-	13,345	525	4%	94.1	0.5	80.1	100%

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What is MERV?

Minimum Efficiency Reporting Value, commonly known as MERV, is a measurement scale designed in 1987 by the American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE) to report the effectiveness of air filters in more detail than other ratings.

Basically, the higher the MERV rating, the higher the air filtration capabilities of a particular filter.

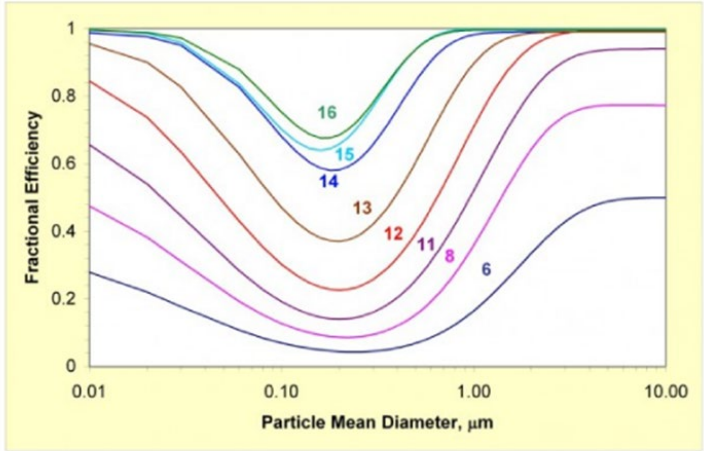
MERV ratings range from 1 to 20, with 1 being the lowest level of filtration, and 20 being the highest.

Filters that are MERV 16 through 20 are usually only found in hospitals, cleanrooms, and nuclear power plants. The home air filters you're looking for are rated anywhere between MERV 5 and 13.

MERV

Minimum **E**ffciency

Reporting **V**alue



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Strong

MERV 8

Pollen	✓
Dust/Lint	✓
Dust Mites	✓
Debris	✓
Pet Dander	✓
Mold Spores	
Car Fumes & Smog	
Tobacco Smoke	
Smoke	
Bacteria	
Virus Carriers	
Microscopic Allergens	

Stronger

MERV 11

Pollen	✓
Dust/Lint	✓
Dust Mites	✓
Debris	✓
Pet Dander	✓
Mold Spores	✓
Car Fumes & Smog	✓
Tobacco Smoke	
Smoke	
Bacteria	
Virus Carriers	
Microscopic Allergens	

Strongest

MERV 13

Pollen	✓
Dust/Lint	✓
Dust Mites	✓
Debris	✓
Pet Dander	✓
Mold Spores	✓
Car Fumes & Smog	✓
Tobacco Smoke	✓
Smoke	✓
Bacteria	✓
Virus Carriers	✓
Microscopic Allergens	✓

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ASHRAE EPIDEMIC TASK FORCE

Core Recommendations for Reducing Airborne Infectious Aerosol Exposure in Buildings

1. Follow public health guidelines
2. Increase ventilation, filtration, and air cleaning
3. Air distribution: promote mixing of space air without causing strong air currents
4. HVAC Operations: maintain temperatures, humidity, and clean air supply
5. Verify that HVAC systems are functioning as designed

Source: https://www.ashrae.org/file%20library/technical%20resources/covid-19/core-recommendations-for-reducing-airborne-infectious-aerosol-exposure.pdf

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Steps taken by FM to Reduce Covid Exposure via HVAC Systems

- Monitored and implemented guidance coming from the CDC, WHO, ASHRAE, etc.
- Evaluated all campus air handlers to ensure proper operations
- Evaluated and documented the air changes per hour in all classrooms
- Increased ventilation to maximize fresh air entering our buildings
- Increased air filtration levels to MERV 13 in all major air handlers
- Continue to service all campus air handlers on a quarterly schedule
- Purchased desktop carbon dioxide (CO2) monitors* and HEPA filtered air scrubbers which are available for use in areas with lower air changes per hour

*CO2 monitors indicates the level of exhaled air in a room – and may serve as a proxy indicator for the risk of Covid-19 virus particles spread through aerosols, if infected individuals are present.

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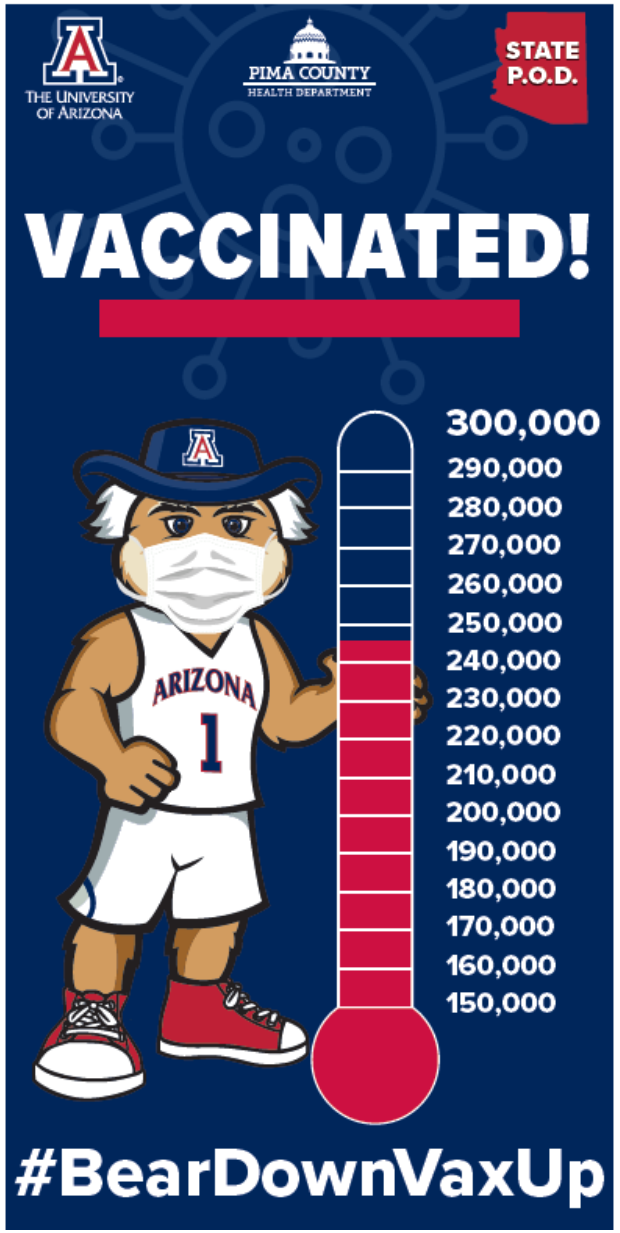

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https://youtu.be/W1cqb5jujs4

Occupational Exposure and Ventilation Principles

Paloma I. Beamer, PhD

Past President, International Society of Exposure Science

Professor, Environmental Health Sciences, College of Public Health

Asthma and Airway Disease Research Center

Bio5 Institute

Chemical and Environmental Engineering

American Indian Studies (GIDP)

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Risk Minimization and Prevention of Infection

- Probability of infection risk is a function of the total dose of the virus during an incubation period
- Focus on controlling…

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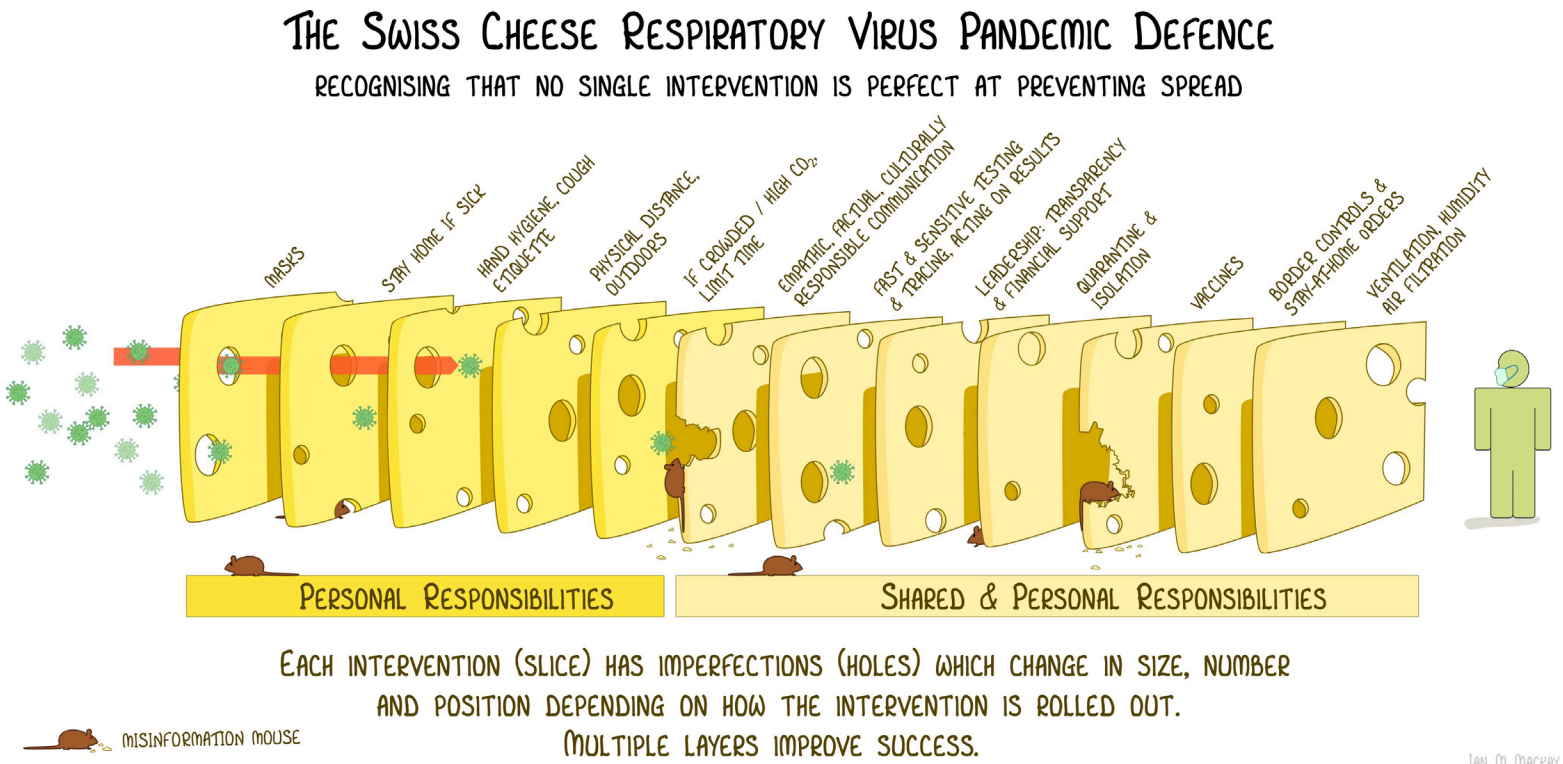
Fundamental Control Assumptions

- All exposures can be controlled to some degree and by some method
- Controls may not completely control the exposure
- More than one control may be useful or required
- ***Using multiple controls simultaneously will increase the overall effectiveness in minimizing risk and preventing infection***



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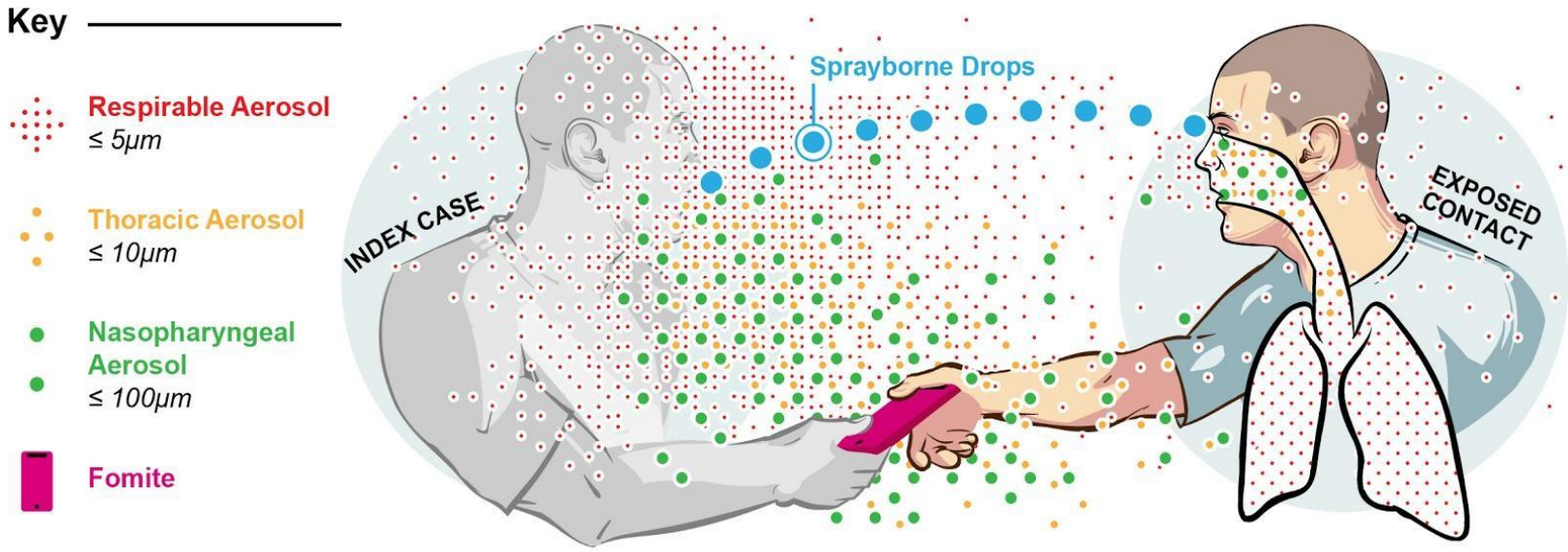
Exposure Control must consider….

- source (infected person)
- pathway
- susceptible person



https://tinyurl.com/FAQ-aerosols

source path susceptible person

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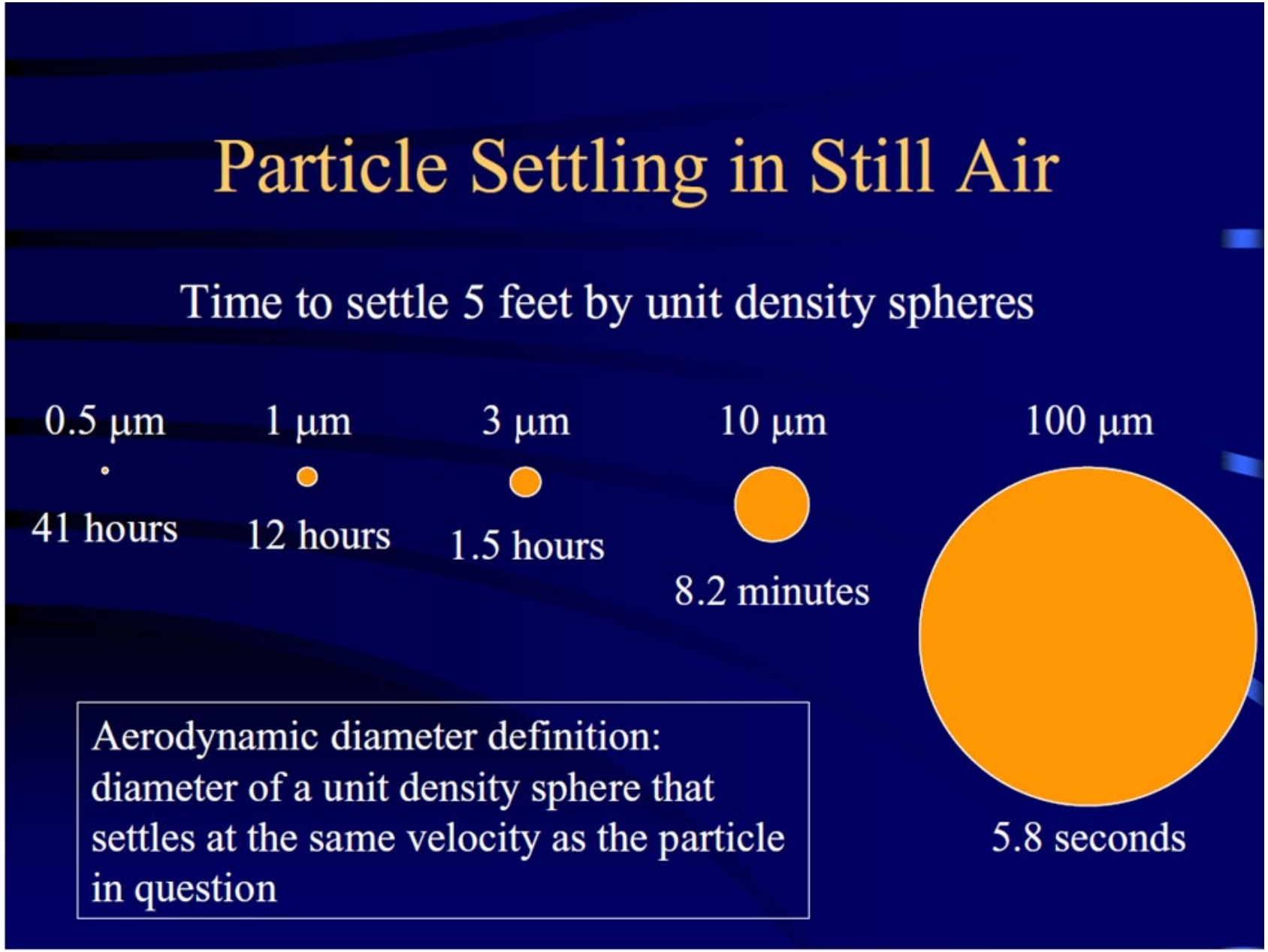

Figure: time for particles of different sizes to settle to the ground in still air, from the height of a person. From the [CDC "Aerosols 101" presentation]

https://tinyurl.com/FAQ-aerosols

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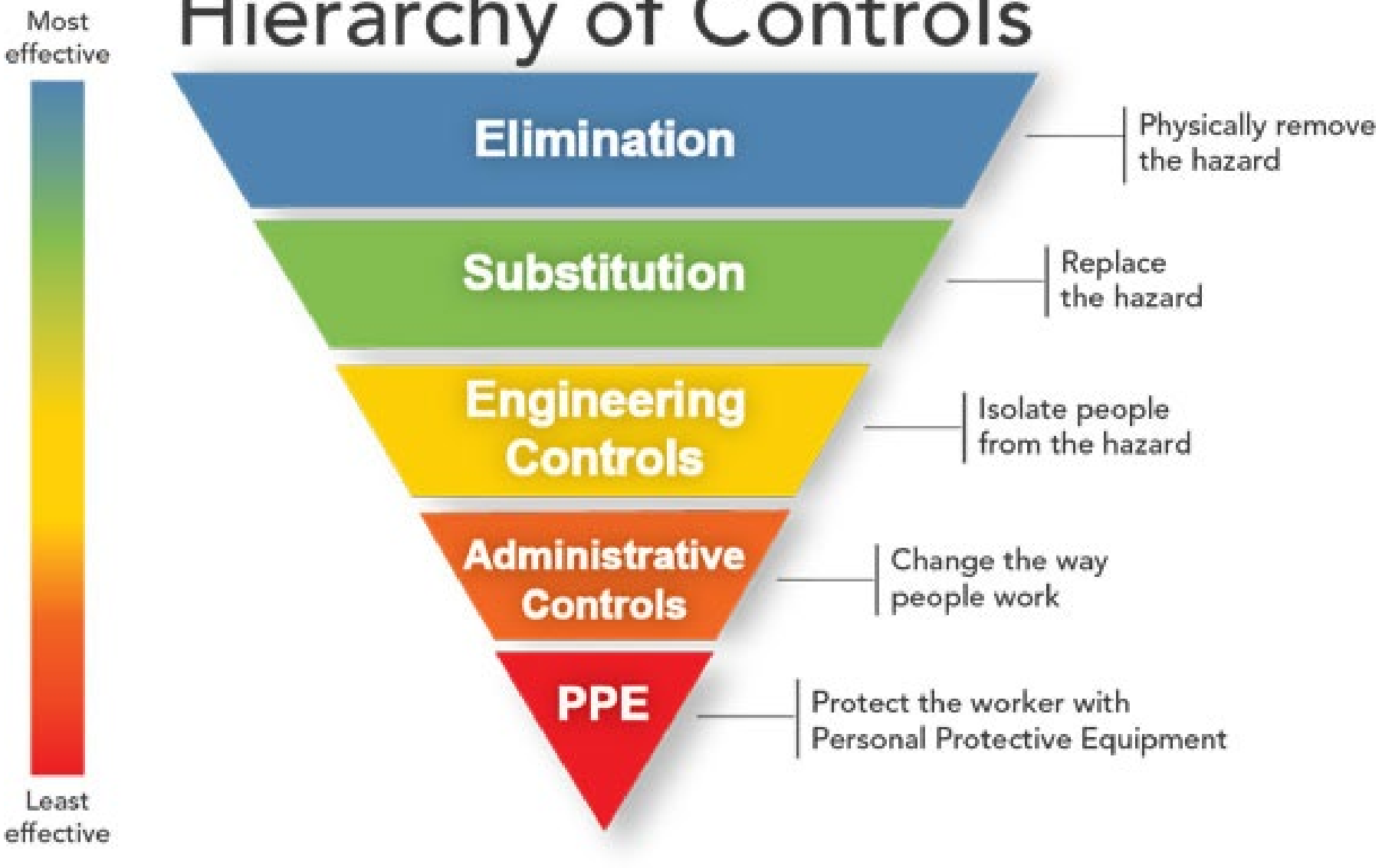
Source

Path

Person

Hierarchy of Controls



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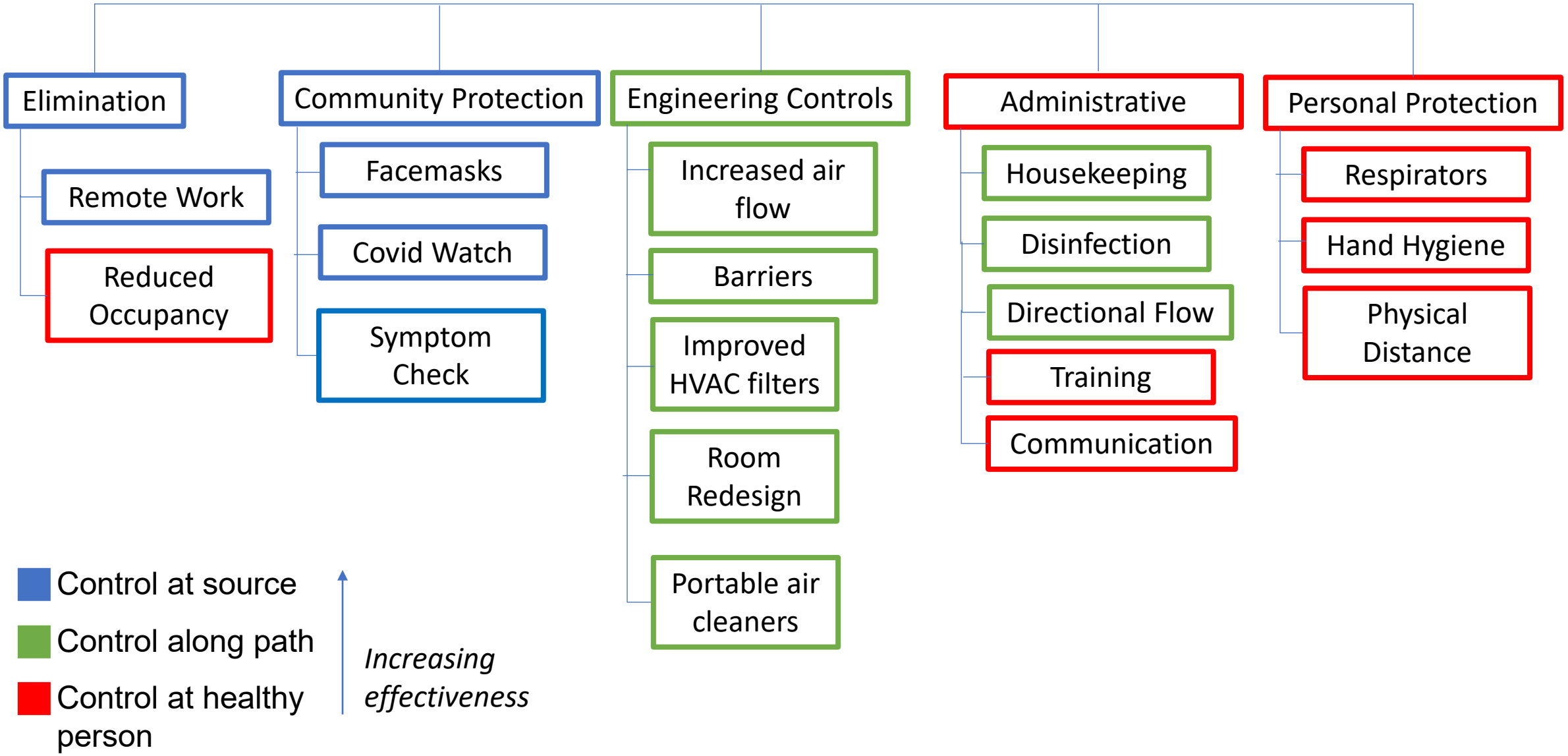
Multi-pronged virus prevention techniques



Ventilation and Airborne Transmission

Goal: Reduce the build-up of aerosols that potentially contain SARS-CoV-2 to reduce inhalation exposure and dose

Clean the air by filtering

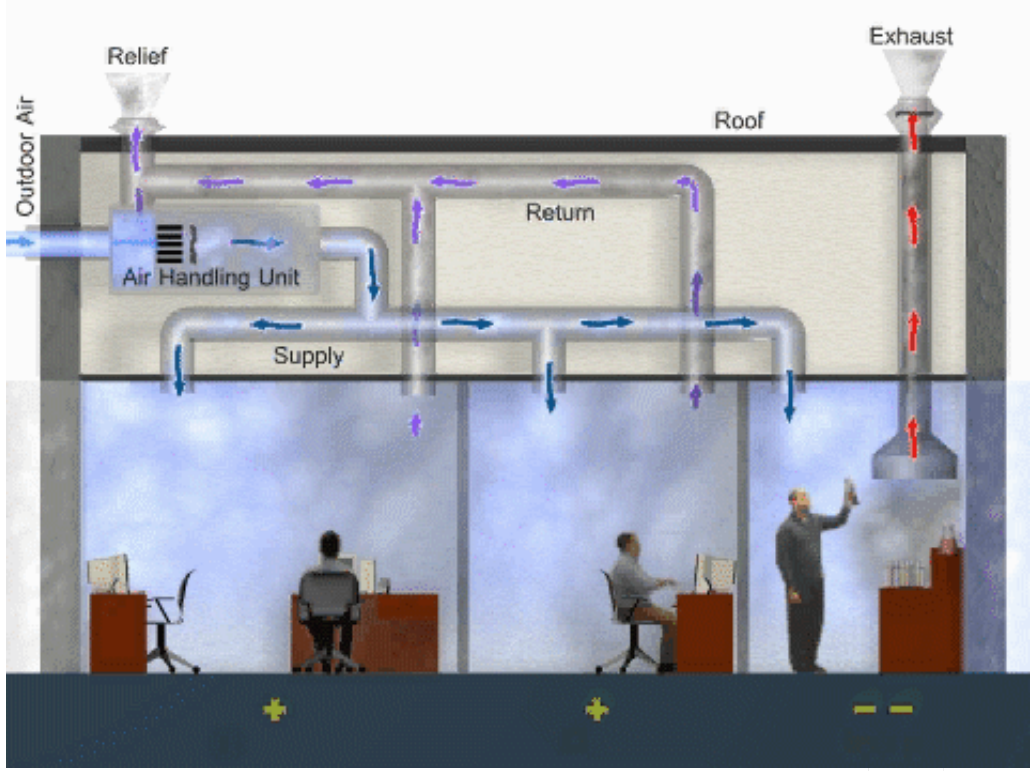
- Upgrade filters in HVAC system
- Use portable air cleaners

Dilute the concentration

- Open windows and doors when possible
- Increase outdoor air delivery rate in HVAC system

Maintenance and evaluation

- Measure ventilation rates to ensure working as planned
- Change filters regularly
- Supplement with portable air cleaners as necessary



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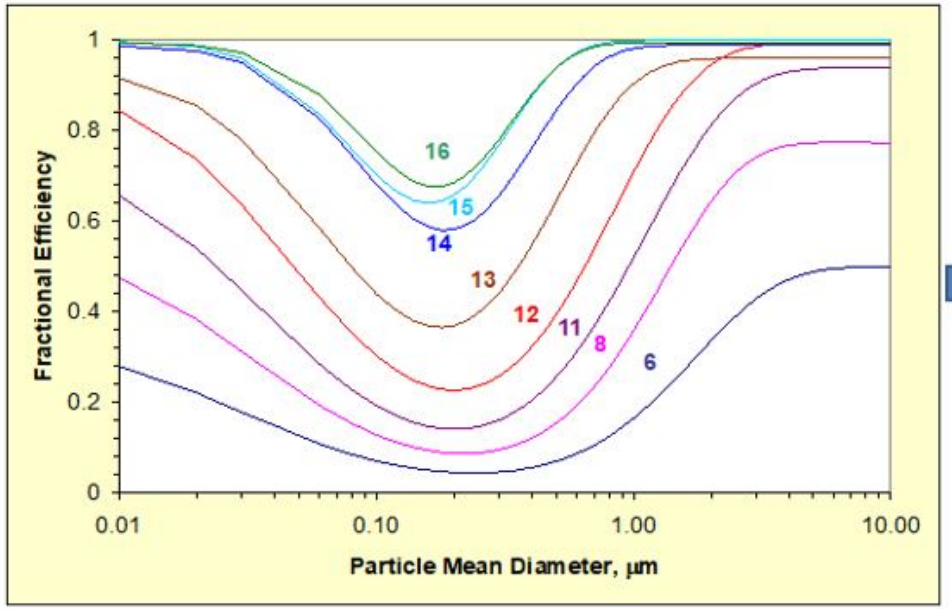
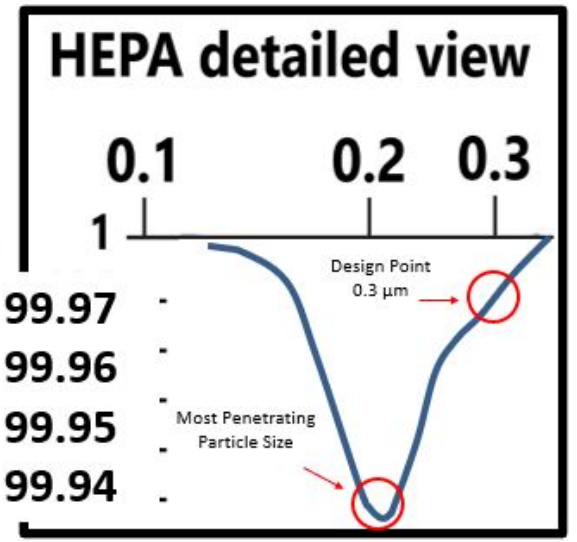
HVAC systems and filters

- Minimum Efficiency Reporting Value (MERV) from an ASHRAE 52.2 test
  - MERV ranges from 1 to 16; higher MERV = higher efficiency
  - MERV ≥13 (or ISO ePM1) are efficient at capturing airborne viruses
- High efficiency particulate air (HEPA) filters are more efficient than MERV 16 filters, but can't be used in most commercial HVAC systems
- Ensure ducts are cleaned and sealed with no leaks





https://www.ashrae.org/technical-resources/filtration-disinfection#mechanical

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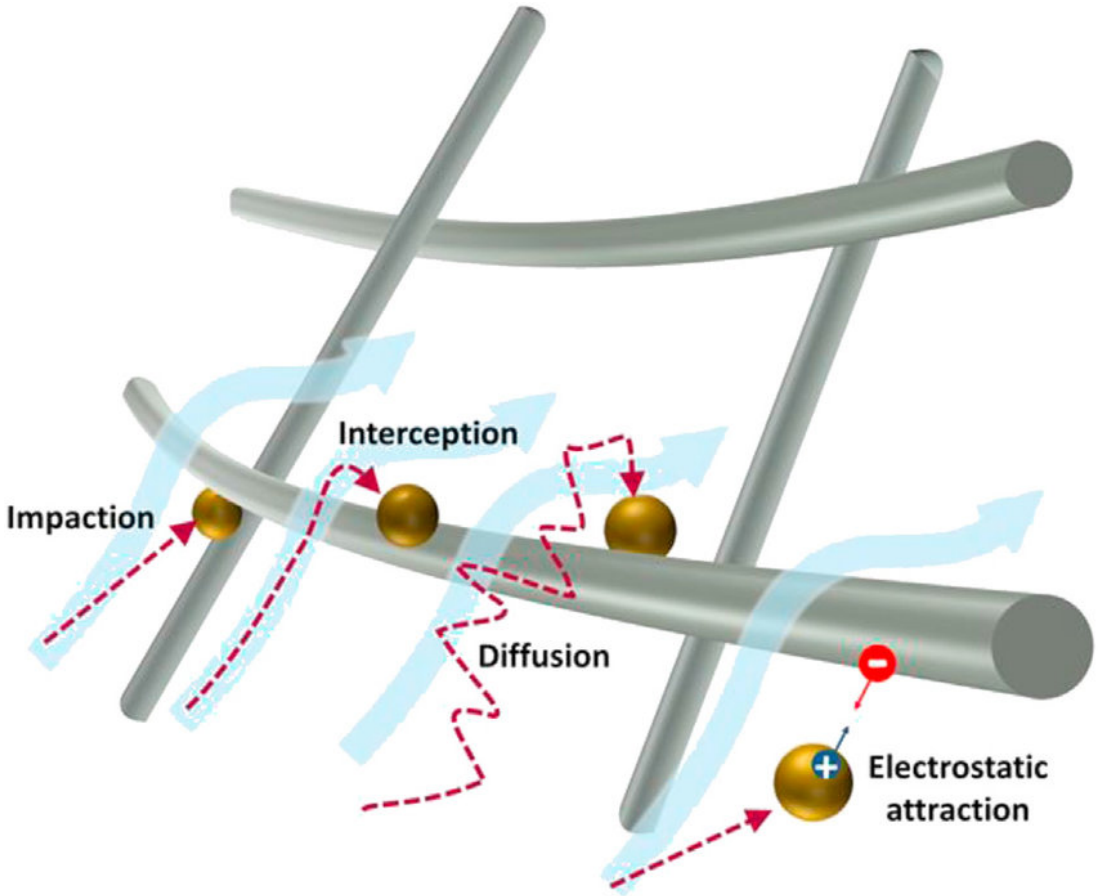
Filtration Mechanisms



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Relationship between Flow, ACH, Occupancy

- Flow rate (Q) is the volume of air that enters a space per unit time
  - Cubic feet per minute (CFM)
  - Liters per second (L/s)
- Air Exchange Rate (ACH) is the amount of time it takes to completely replace the complete volume of air of the room and is often reported in ACH (air changes per hour)
  - ACH = Q/V
  - V = room volume
- Indoor air quality guidelines are often normalized by number of occupants (N)
  - Q per person = Q/N = ACH*V/N

Ventilation Recommendations

- WHO Roadmap to Ventilation during COVID-19
  - Non-residential Settings
    - 10 L/s/person
  - https://apps.who.int/iris/bitstream/handle/10665/339857/9789240021280-eng.pdf?sequence=1&isAllowed=y

- Harvard Healthy Buildings
  - 4-6 ACH for non-clinical settings
  - https://jamanetwork.com/journals/jama/fullarticle/2779062

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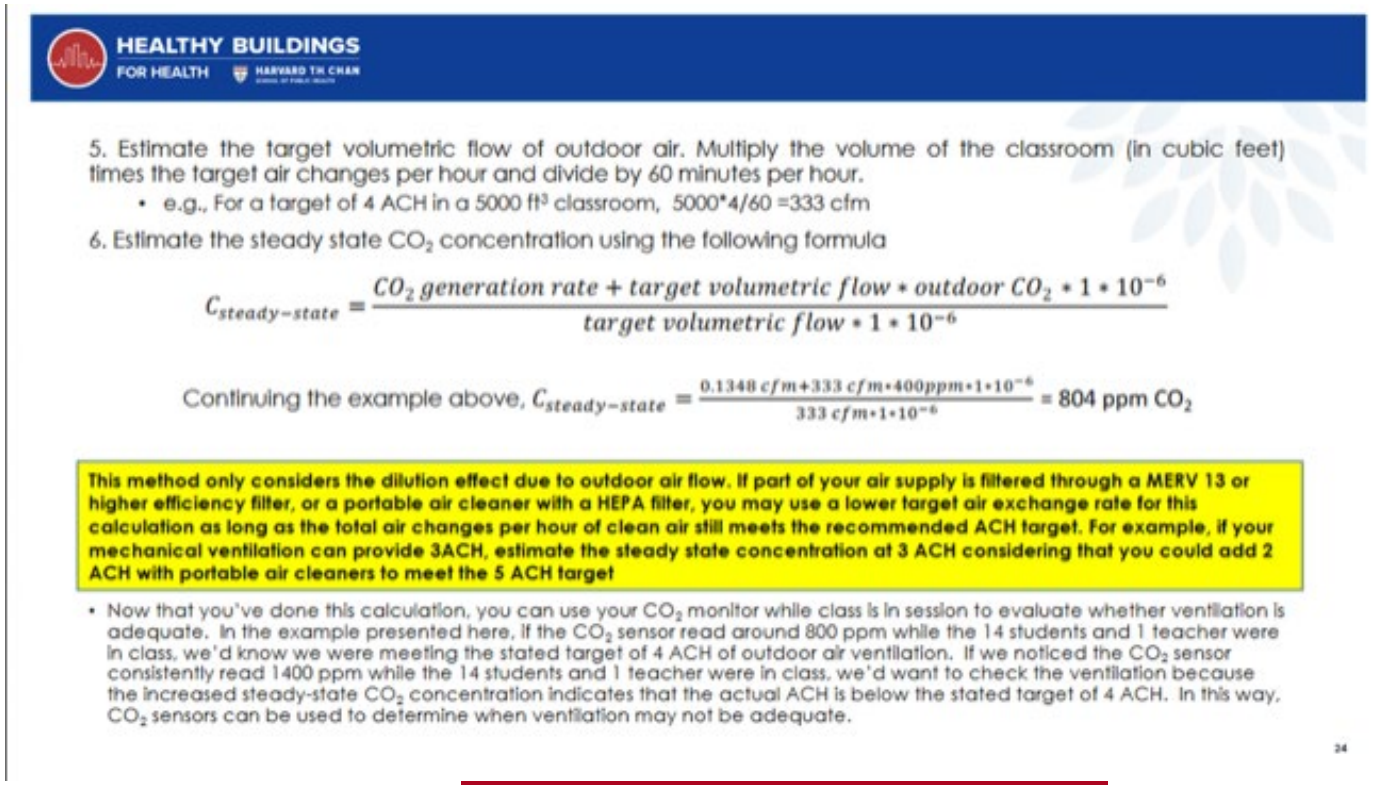
How to use a CO2 monitor to measure ACH?

- Measure CO_2 steady state concentration, number of people and room volume
- Use calculator to estimate air exchange rate
  - Harvard Healthy Buildings Programs
  - https://docs.google.com/spreadsheets/d/1wG0dO0Su75iBuUCmY5WpfYtQlTKbQ1UzJOeBVbDxJks/edit#gid=1039758887



HEALTHY BUILDINGS FOR HEALTH HARVARD T.H. CHAN

5. Estimate the target volumetric flow of outdoor air. Multiply the volume of the classroom (in cubic feet) times the target air changes per hour and divide by 60 minutes per hour.
   - e.g., For a target of 4 ACH in a 5000 ft³ classroom, 5000*4/60 =333 cfm

6. Estimate the steady state CO_2 concentration using the following formula

$$C_{steady-state} = \frac{CO_2\ generation\ rate + target\ volumetric\ flow * outdoor\ CO_2 * 1 * 10^{-6}}{target\ volumetric\ flow * 1 * 10^{-6}}$$

Continuing the example above, $C_{steady-state} = \frac{0.1348\ cfm + 333\ cfm * 400ppm * 1 * 10^{-6}}{333\ cfm * 1 * 10^{-6}}$ = 804 ppm CO_2

This method only considers the dilution effect due to outdoor air flow. If part of your air supply is filtered through a MERV 13 or higher efficiency filter, or a portable air cleaner with a HEPA filter, you may use a lower target air exchange rate for this calculation as long as the total air changes per hour of clean air still meets the recommended ACH target. For example, if your mechanical ventilation can provide 3ACH, estimate the steady state concentration at 3 ACH considering that you could add 2 ACH with portable air cleaners to meet the 5 ACH target

- Now that you've done this calculation, you can use your CO_2 monitor while class is in session to evaluate whether ventilation is adequate. In the example presented here, if the CO_2 sensor read around 800 ppm while the 14 students and 1 teacher were in class, we'd know we were meeting the stated target of 4 ACH of outdoor air ventilation. If we noticed the CO_2 sensor consistently read 1400 ppm while the 14 students and 1 teacher were in class, we'd want to check the ventilation because the increased steady-state CO_2 concentration indicates that the actual ACH is below the stated target of 4 ACH. In this way, CO_2 sensors can be used to determine when ventilation may not be adequate.

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Using a Simple-to-Read **Carbon Dioxide (CO_2) Monitor** to Evaluate Ventilation in Your Workspace

TU TRABAJO NO TE DEBE DAÑAR
YOUR JOB SHOULDN'T HURT YOU

Proper ventilation can help decrease COVID-19 transmission indoors.

1. What is a CO_2 Monitor?

- ❑ CO_2 monitors help you determine how much of the air in a room has been exhaled by you or someone else. High CO_2 levels means more exhaled air.
- ❑ The more exhaled air there is building up in a room, the more likely it is that *if someone in the room has COVID-19* (even without symptoms), the virus is circulating in the room's air.

Note: *While UV-C lamps, HEPA filters, portable air cleaners, and some HVAC filters* can lower the amount of virus in the air, they won't change CO_2 levels.*

**MERV-13 filters or higher are recommended to minimize virus transmission, but not all HVAC systems are compatible. Check your system requirements before installing new filters.*

2. How do I use a CO_2 Monitor?

- ❑ Place monitor near the middle of a room, away from the incoming AC vents, and about 5 feet off the floor.
- ❑ Some monitors use color-coded lights to indicate different levels.

CO_2 Level	Action
400 - 700	Ventilation is good. Risk is minimal.
700 - 1000	CO_2 levels are elevated. Keep an eye on monitor, and open windows and doors if possible.
More than 1000	More than 1% of the air in the space has been exhaled by someone. Consider taking a quick break and having everyone leave the space until levels drop below 700.

3. What kind of CO_2 monitor should I get, and where can I get it?

- ❑ NDIR (non-dispersive infrared) CO_2 monitors work the best and cost about $100-$200.
- ❑ Some options for purchasing monitors online:

Indoor CO2 Meter PCE-CMM 5 CO2 Detector

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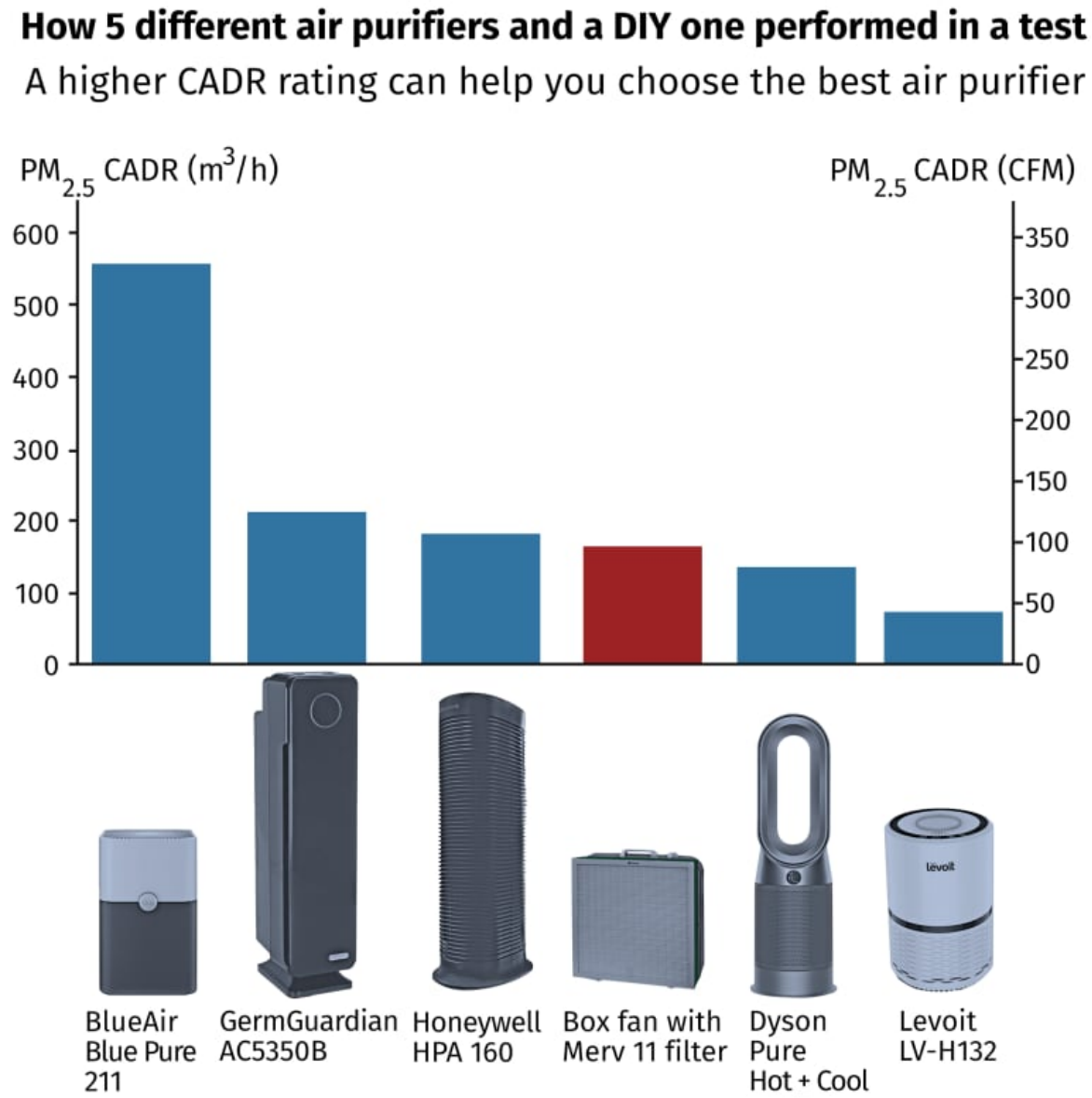

Selecting a Portable Air Cleaner

- If air exchange is less than 6 ACH:
  - Calculate flow in CFM that you need to reach 6 ACH
  - Air cleaner should have Clean Air Delivery Rate (CADR) that equals that flow

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A CIVIC DUTY

COVID-19 Avoid

Crowding

Indoors

low **V**entilation

Close Proximity

Long **D**uration

Unmasked

Talking
singing
Yelling
breathing hard

https://tinyurl.com/FAQ-aerosols

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References

- WHO Roadmap to ventilation during COVID-19
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  - https://forhealth.org/tools/
- SAFEAIRSPACES COVID-19 Aerosol Relative Risk Estimator
  - Risk Calculator: https://safeairspaces.com/safeairspaces-estimator
- Sonora Environmental Research Institute
  - Resources for small businesses on COVID-19
  - https://seriaz.org/business-assistance/supporting-small-businesses-during-covid-19/
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QUESTIONS & DISCUSSION

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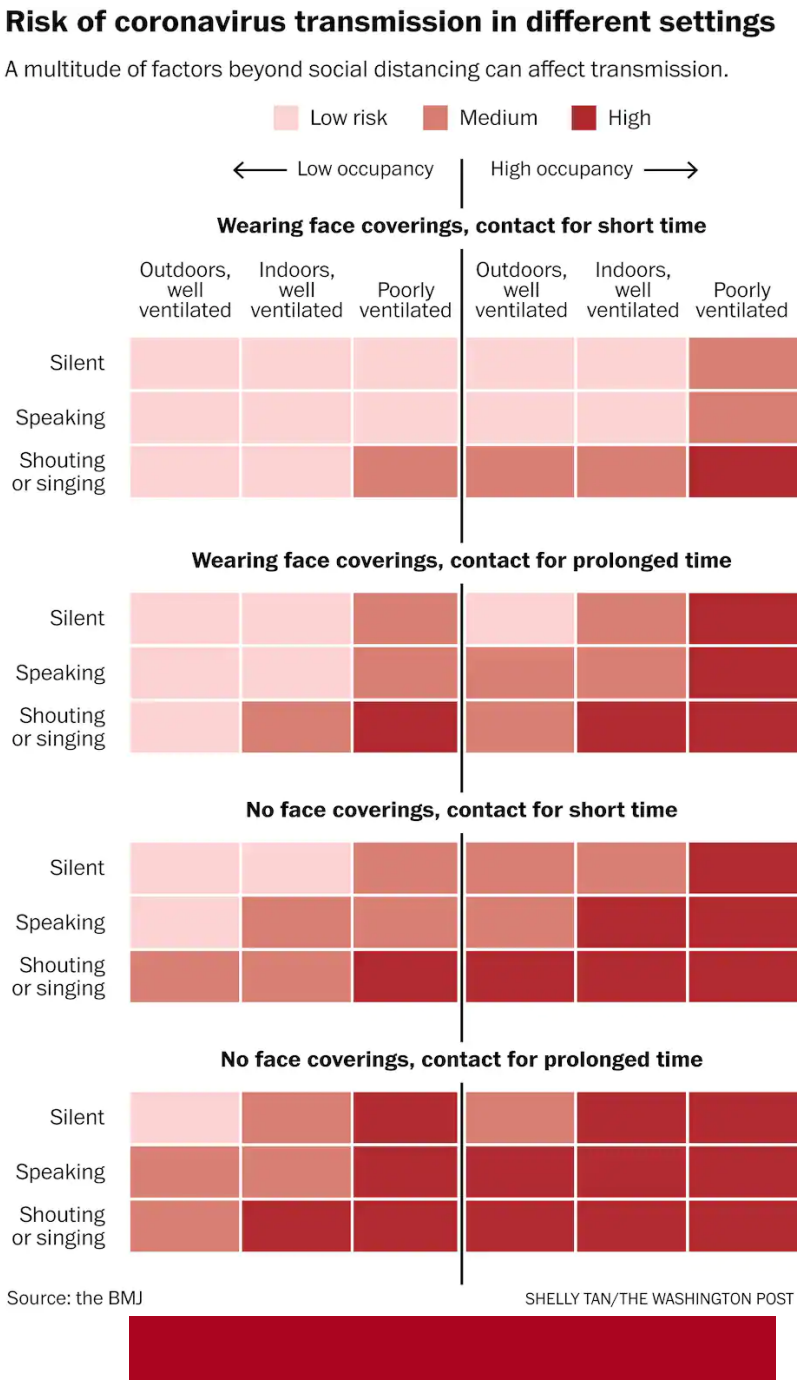

Figure: estimated relative risk of COVID-19 transmission for different activities. Table from [Jones et al. (2020)], as [redrawn by the Washington Post]. (We understand that the table is qualitative, and there is some debate about some details. We plan to work in an improved version of this table using the aerosol transmission estimator).

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https://tinyurl.com/FAQ-aerosols